

Hydroxylapatite

Ca₅(PO₄)₃(OH)

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Crystal Data: Hexagonal. *Point Group:* 6/*m*. As tabular to prismatic crystals, to 30 cm; usually as stalagmites, nodules, in crystalline to massive crusts.

Physical Properties: *Cleavage:* Poor on {0001} and {10 $\bar{1}$ 0}. *Fracture:* Conchoidal. *Tenacity:* Brittle. Hardness = 5 D(meas.) = 3.14–3.21 D(calc.) = 3.16

Optical Properties: Transparent to translucent. *Color:* White, wax-yellow, sea-green, brown, black. *Luster:* Vitreous to subresinous, earthy.

Optical Class: Uniaxial (-). *Pleochroism:* Weak to moderate; colorless to pale colors.

Absorption: $E > O$. $\omega = 1.642\text{--}1.658$ $\epsilon = 1.637\text{--}1.654$

Cell Data: *Space Group:* $P6_3/m$. $a = 9.4166$ $c = 6.8745$ $Z = 2$

X-ray Powder Pattern: Synthetic. (ICDD 9-432).

2.814 (100), 2.778 (60), 2.720 (60), 3.44 (40), 1.841 (40), 1.943 (30), 2.631 (25)

Chemistry:	(1)	(2)
P ₂ O ₅	42.05	42.39
MnO	0.07	
MgO	0.10	
CaO	55.84	55.82
F	0.16	
Cl	trace	
H ₂ O	1.86	1.79
-O = (F, Cl) ₂	0.07	
Total	100.01	100.00

(1) Holly Springs, Georgia, USA; corresponding to (Ca_{5.05}Mg_{0.01})_{Σ=5.06}(PO₄)₃[(OH)_{1.04}F_{0.08}]_{Σ=1.12}. (2) Ca₅(PO₄)₃(OH).

Mineral Group: Apatite group; OH > F or Cl.

Occurrence: Much less common than fluorapatite. Formed by the reaction of limestone with phosphatic solutions derived from guano. In talc schists associated with serpentinite. As a fracture-localized alteration of montebasite in a complex granite pegmatite.

Association: Brushite, calcite (caves); talc, serpentine (schists); montebasite, crandallite, muscovite (pegmatite).

Distribution: From Chämleten (Kemmlen), near Hospental, Uri, Switzerland. In the Kaiserstuhl, Baden-Württemberg, Germany. At Punta della Rossa, Val Devero, Ossola, Italy. In the USA, in the Verde Antique quarry, Holly Springs, Cherokee Co., Georgia; from the Midnight Owl pegmatite, White Picacho district, Maricopa Co., Arizona. Large crystals in the Gardiner complex, beyond the head of Kangerdlugssuaq Fiord, East Greenland. On Mona Island, West Indies, Caribbean Sea. From caves worldwide; studied material from Low Water Bridge Cave, Greene Co., Missouri, USA.

Name: For dominant *hydroxyl* and membership in the *apatite* group; see fluorapatite.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 879–889. (2) Chang, L.L.Y., R.A. Howie, and J. Zussman (1996) Rock-forming minerals, (2nd edition), v. 5B, non-silicates, 297–334. (3) Phillips, W.R. and D.T. Griffen (1981) Optical mineralogy, 81–84. (4) Sommerauer, J. and K. Katz-Lehnert (1985) A new partial substitution mechanism of CO₃²⁻/CO₃OH³⁻ and SiO₄⁴⁻ for the PO₄³⁻ group in hydroxyapatite from the Kaiserstuhl alkaline complex (SW-Germany). *Contr. Mineral. Petrol.*, 91, 360–368. (5) Hughes, J.M., M. Cameron, and K.D. Crowley (1989) Structural variation in natural F, OH, and Cl apatites. *Amer. Mineral.*, 74, 870–876.

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